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The Bogalusa Brand

Select Long Leaf Pine
Structural Timbers

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Structural Timbers

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CCA

Bedding material
691

Lumber 691



Typical of Long Leaf Timber From Which BOGALUSA Brand Timbers Are Cut

Select Structural Material

Its Characteristics and Uses



(1915)

Manufactured from
Genuine Long Leaf Pine (*Pinus palustris*)

by the

Great Southern Lumber Company
Bogalusa, Louisiana

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GREAT SOUTHERN LUMBER COMPANY
BOGALUSA, LOUISIANA

Select Structural Material



SOUTHERN yellow pine timber resists, in an exceptional degree, *all* of the stresses developed in structures. These stresses are tension, compression parallel and perpendicular to the grain and shear parallel to the grain. Wood is the only natural structural material that has the ability to resist all of these stresses in the right proportions. The physical properties of the southern yellow pines are so scientifically adjusted by nature that these species are used for structural purposes to a greater extent than all of the others.

It is a natural law, correspondent to the coniferous woods, that the strength varies with the specific dry weight and density.

It is the quality of great density and specific dry weight that makes the longleaf species the strongest of the structural woods. This is supplemented by a straight grain and a comparative freedom from serious defects. This species is also distinguished by a large resin content and small percentage of sapwood. It is these qualities that make it the most durable of woods when exposed to the elements or to conditions of high constant temperature and relatively high humidity.*

Longleaf pine (*Pinus palustris*) is eminently qualified for use in bridges and trestles where great strength and durability are essential. Timbers for such structures must show a large percentage of heartwood and the other properties required by the Standard Specifications for Southern Yellow Pine Bridge and Trestle Timbers adopted by the American Railway Engineering Association. It is also adapted for use in factories and warehouses where great strength is required and in textile mills where durability and resistance to dry rot are the essential factors. It is the strongest because it is the most dense and the most durable because the most resinous.

The use of wood for structural purposes is confined almost exclusively to the conifers. The annual cut of coniferous wood in the United States is thirty-four billion feet, board measure, which is 76 per cent of the total cut, including the hardwoods. Of the coniferous woods cut, the Southern Yellow Pines amount to 37 per cent, or four times as much as the most plentiful competing wood. The predominating species of these woods are the longleaf and shortleaf; 232.3 billion feet of longleaf and 152.1 billion feet of shortleaf and loblolly, contributing to the total of 634 billion feet of standing timber in the Southern Pine region; cypress 40.4 billion feet; and all hardwoods together, 209.2 billion feet.**

*See Mechanical Properties of Woods Grown in the United States, United States Forest Service, Circular 213; The Mechanical Properties of Wood, by Prof. S. J. Record; Lumber and Its Uses, by R. S. Kellogg.

**The Lumber Industry, Part I, Standing Timber, Department of Commerce and Labor, Bureau of Corporations, 1913.

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Steam Skidders and Loaders are Important Factors in the Logging Operation at BOGALUSA

It is a recognized fact that the type of building construction known as "standard mill" possesses advantages not equaled by any other type of construction when used for factories, warehouses and other commercial purposes. These advantages are economy in cost of construction, and a very high degree of fire resistance when built and equipped with automatic sprinklers as specified by the Associated Factory Mutual Fire Insurance Companies. One of the greatest advantages of this type of construction is that such buildings are flexible; they can be easily altered for different kinds of occupancy. This is not the case with the fixed and inflexible concrete building.

With the rapid growth of American cities and the changing character of localities it is often necessary to remove perfectly good structures. A notable example was the demolition and rebuilding of the Albert Dickinson Company's extensive warehouses in Chicago. After being in use twenty-two years every piece of Southern Yellow Pine Timber was reused in the new plant.

The fire hazard to buildings and contents, in properly constructed and equipped buildings of this type, does not exceed that in buildings of any other type used for the same purposes. *For buildings of standard mill construction, a long and satisfactory experience with Southern Longleaf Yellow Pine demonstrates the unchallenged superiority of that wood.*



One of the Big Combination Steam Skidder-Loaders that Keep the BOGALUSA Plant Supplied with Raw Material

The strength of Southern Long Leaf Yellow Pine is not affected by preserving with creosote,* while some other coniferous woods show a marked loss in strength after receiving this treatment.**

SOUTHERN YELLOW PINE

Standard Specifications and Grading Rules

HOW can the architect or engineer secure the best results in using this material? First, by selecting the proper grade of material according to any of the specifications hereinafter mentioned, and suitable for the use to which the material is to be put.

The standardization of the manufacture and grading of Southern Yellow Pine originated about twenty years ago in the Southern Lumber Manufacturers' Association, which organization was succeeded by the Yellow Pine Manufacturers' Association and the Southern Pine Association. This organization was always in the lead in this work but during this time the standardization of manufacture and grading was also undertaken by the Atlantic Coast Association, which originated what are known as the Interstate Rules of 1905.

*See Bulletin 149. American Railway Engineering Association.

**See Bulletin 168. American Railway Engineering Association.



The Saw Mill and Log Pond. These Long Leaf Logs Make BOGALUSA Brand Timbers

All of these standard grading rules were based on a permissible maximum number of defects and disregarded entirely the strength and durability of the wood. Hence we have such grades as Standard, Merchantable and Prime on the Atlantic coast and the old grades of No. 1 and No. 2 common in the central portion of the country. In no case do these rules provide for the necessities of the architect and engineer, inasmuch as they do not fix any strength value and it is principally strength and durability with which structural experts are concerned.

As a result of these unscientific grading rules it has been difficult to procure a satisfactory material having a dependable and uniformly measurable strength; this situation causing engineers and architects to use other materials of construction. Such difficulty in securing suitable material finally led to a demand on the part of those writing specifications for a grading rule based on strength quality.

The first effort to meet with this demand was that of the American Railway Engineering Association, always a leader in engineering progress, whose members in 1909 adopted the standard specification for bridge and trestle timbers. Early in 1914 the Forest Service, United States Department of Agriculture, made a



Handling Long Leaf Structural Timbers on the Timber Dock at BOGALUSA



Heavy Long Leaf Timbers of Exceptional Quality Bearing the BOGALUSA Brand

rule to govern the purchases of yellow pine used in the construction of the Panama Canal. On May 4, 1914, a committee of the Yellow Pine Manufacturers' Association approved a rule for "structural grades" based on the density and strength quality of the wood. This action was followed shortly thereafter by the Georgia-Florida Saw Mill Association by the adoption of a similar rule adapted to the forests controlled by that association.

The latest rules to be adopted are those of the Southern Pine Association, in 1915, which are based largely on the investigations and recommendations of the Forest Service. On March 15, 1915, the Inspection Department of the Associated Factory Mutual Fire Insurance Companies issued specifications for a special grade of longleaf pine for use in Mutual factories. These specifications provide for branding the material at the mill and are complete in that they grade for durability as well as strength. They are based on the results of investigation of a large number of recent cases of dry rot in factories in which defective material had been used.

In subsequent pages are given the current grading rules as follows:

- (1) Specifications of the Associated Factory Mutual Fire Insurance Companies of 1915. (These specifications call for the very highest grade of structural timbers.)
- (2) Select Structural Grade adopted by the American Society for Testing Materials and the Southern Pine Association, 1915.
- (3) Standard Grades of the Southern Pine Association, adopted 1915.
- (4) Standard Grades of the American Railway Engineering Association, adopted 1909.

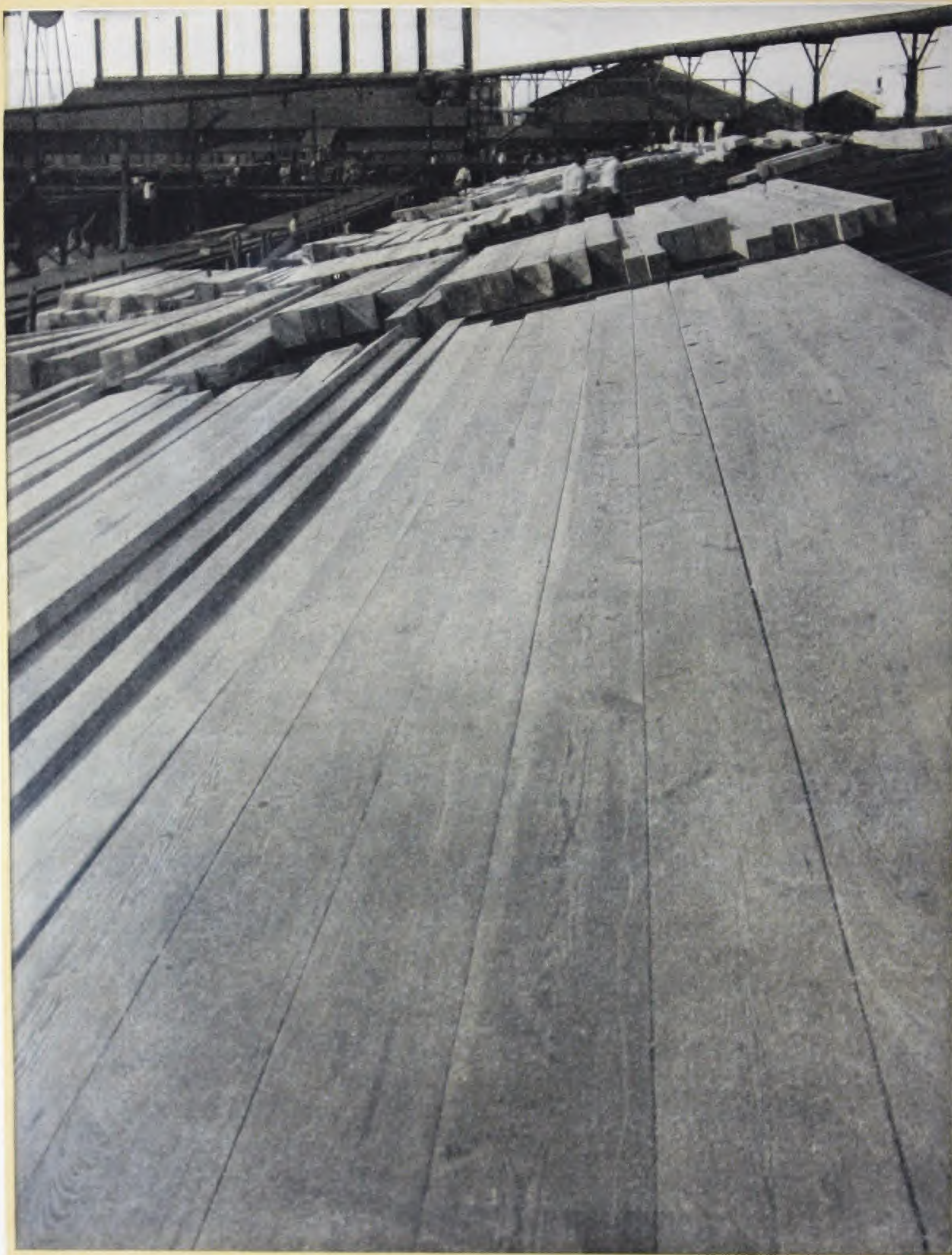
The Standard Specification for Yellow Pine Bridge and Trestle Timbers adopted by the American Society for Testing Materials, September 1, 1910, is in effect identical with that of the American Railway Engineering Association and the suggested rule of the United States Forest Service and the rule of the Georgia-Florida Saw Mill Association (adopted in 1914) are similar to, but not so specific as that adopted by the Southern Pine Association. The Interstate Rules of 1905 are no longer in accord with approved engineering practice; hence these rules are omitted.

Southern Yellow Pine is manufactured to conform to the standard sizes and dressing of the Southern Pine Association. For the use of engineers and architects a table of the nominal and actual sizes has been prepared, to which has been added data concerning the properties of the sections. This data is of the same kind that is used in connection with steel construction and affords the designer in wood construction the same facilities for accurate work.*

Branded material safeguards the purchaser and the writer of the specification by locating the source of supply and the responsibility of the inspection service.

After selecting the grade and specification, the designer should further require that the material bear the brand BOGALUSA, which signifies that the material is genuine longleaf pine (*Pinus palustris*) properly manufactured and carefully graded.

*See pages 20-23.



Select Long Leaf Timbers are Always in Plentiful Supply at BOGALUSA



Every Timber on the Dock is Branded BOGALUSA, Signifying Long Leaf Pine Material of the Best Quality

SOUTHERN LONG LEAF YELLOW PINE

Where to Get it.

THE GREAT SOUTHERN LUMBER COMPANY, located at BOGALUSA, Louisiana, is satisfying the growing demand for a scientifically graded and branded material of uniform quality by applying the dependable brand BOGALUSA to its products. Thus branded, this company is prepared to furnish longleaf yellow pine, every stick of which conforms to the grades mentioned whether domestic or export.

The enormous output of the Bogalusa Mills makes the most uniform grading of structural timber not only possible, but highly practicable.

The mills of the GREAT SOUTHERN LUMBER COMPANY at BOGALUSA, are the largest in the world, with a daily capacity of 1,000,000 board feet of manufactured lumber, a large part of this output being composed of heavy structural timbers.

The extensive forests owned by the GREAT SOUTHERN LUMBER COMPANY consist of virgin tracts of southern longleaf yellow pine, enabling it to furnish lumber and structural timber conforming to the most rigid specifications. This

Company's holdings insure its ability to supply such material for many years.

A large modern wood preserving plant is an important department in the Bogalusa organization. By use of chemical treatment good material can be made more durable under exceptionally trying conditions and sappy material which is strong can be made serviceable by increasing its durability. Many of the dry rot cases reported have resulted from sappy, non resinous material which became infected with dry rot germs before being put into the structure. This would have been prevented if this same sappy material had been given a reliable chemical treatment after being sawn before the germs had obtained an entrance.



STANDARD SPECIFICATIONS FOR SOUTHERN YELLOW PINE

Specifications Suggested for a Special Grade of Longleaf Pine for Use in Mutual Factories*

In making contracts for beams, columns and plank to be used in "Slow Burning Construction," the following specifications are recommended:

Density. No part of the material shall have a density of less than 30 pounds per cubic foot when tested by boring smooth holes one inch in diameter and two inches deep in the ends of the stick, drying to constant weight at 212° F. and weighing the borings and computing the density from the volume of the hole.

Rosin. None of the heartwood shall show less than four per cent of rosin by weight when borings are taken with a one inch bit with a hole two inches deep, dried to constant weight at 212° F. and extracted with benzole, the extracted rosin evaporated until it is not soft or sticky when touched with the finger at 70° F.

Heartwood. Heartwood shall show in all four faces of every stick, and sapwood shall not extend more than two inches from the corner at any place, measured perpendicularly to the corner across the face.

Growth Rings. For timbers 6 x 8 inches, or larger, there must show on the cross section between the third and fourth inch, measured radially from the heart center or pith, not less than six annual rings of growth, a majority of which shall show at least one-third summerwood, which is the dark portion of the annual rings; but wide ringed material excluded by this rule will be acceptable, providing that in the majority of the annual rings the dark ring is hard and in width equal to or greater than the adjacent light colored ring.

For pieces in which the center is not included, there must show on the cross section, an average of not less than six annual rings of growth, with not less than one-third summerwood. Timbers will be rejected in which there is no sharp contrast in color between the springwood and summerwood.

Defects. No timber with knots greater than one inch in diameter, or rot, or injurious shakes will be accepted.

Branding. Longleaf pine sold under this specification shall be branded with the letters "F. M.," the name of the lumber manufacturer, the location of the sawmill from which it comes, and the date of sawing, in letters at least one inch high.

Specifications for Southern Yellow Pine Timbers, Adopted by The Southern Pine Association, October, 1915

TIMBER GRADES

The grades of timber are as follows:

"Select Structural Material."
"Merchantable Timbers."

"Square Edge and Sound Timbers."
"No. 1 Common Timbers."

GENERAL TIMBER SPECIFICATIONS

All timber except No. 1 Common must be free from defects such as injurious ring or round shakes, and through shakes that extend to the surface; unsound and loose knots, and knots in groups that will materially impair the strength. Seasoning checks and discolored sap shall not be considered defects in any grade.

Knots

Knots shall be classified as round and spike in form and for quality as sound, encased, loose and unsound.

A *round knot* is oval or circular in form.

A *spike knot* is one sawn in a lengthwise direction.

A *sound knot* is one solid across its face, is as hard as the wood which surrounds it, may be either red or black, and fixed by growth or position so that it will retain its place in the piece.

An *encased knot* is one surrounded in whole or in part by pitch or bark and when grown fast to the piece or fixed by position so that it will retain its place in the piece it shall be considered a sound knot.

A *loose knot* is one not held firmly in place by growth or position.

An *unsound knot* is one not as hard as the wood surrounding it, or one having a hole in it.

*See "Dry Rot in Factory Timbers," by F. J. Hoxie, 1915; Inspection Department Associated Factory Mutual Insurance Companies, Boston.



A General View of the Timber Dock at the BOGALUSA Plant

Wane

Wane is bark on the corner of the piece, or the absence of the corner.

Shakes

Shakes are cracks appearing on the ends of timbers, either intersecting the annual growth rings or separating the same. They shall be classified as ring or round shakes and through shakes.

A ring or round shake is an opening between the annual rings.

A through shake is one extending from the region of the center to the surface of the piece or extending between two faces.

Shakes not hereinbefore described unless known to have extensive penetration shall not be considered a defect under this classification.

Sizes and Lengths

All rough timber, except No. 1 Common, must be full size when green. One-quarter inch shall be allowed for each side surfaced.

Standard lengths are multiples of two feet, eight to twenty feet, inclusive. Extra lengths are multiples of two feet, twenty-two feet and longer. When lineal average is specified, standard of lengths shall be multiples of one foot.

GRADES

The grades of timber shall be designated as follows:

Select Structural Material.

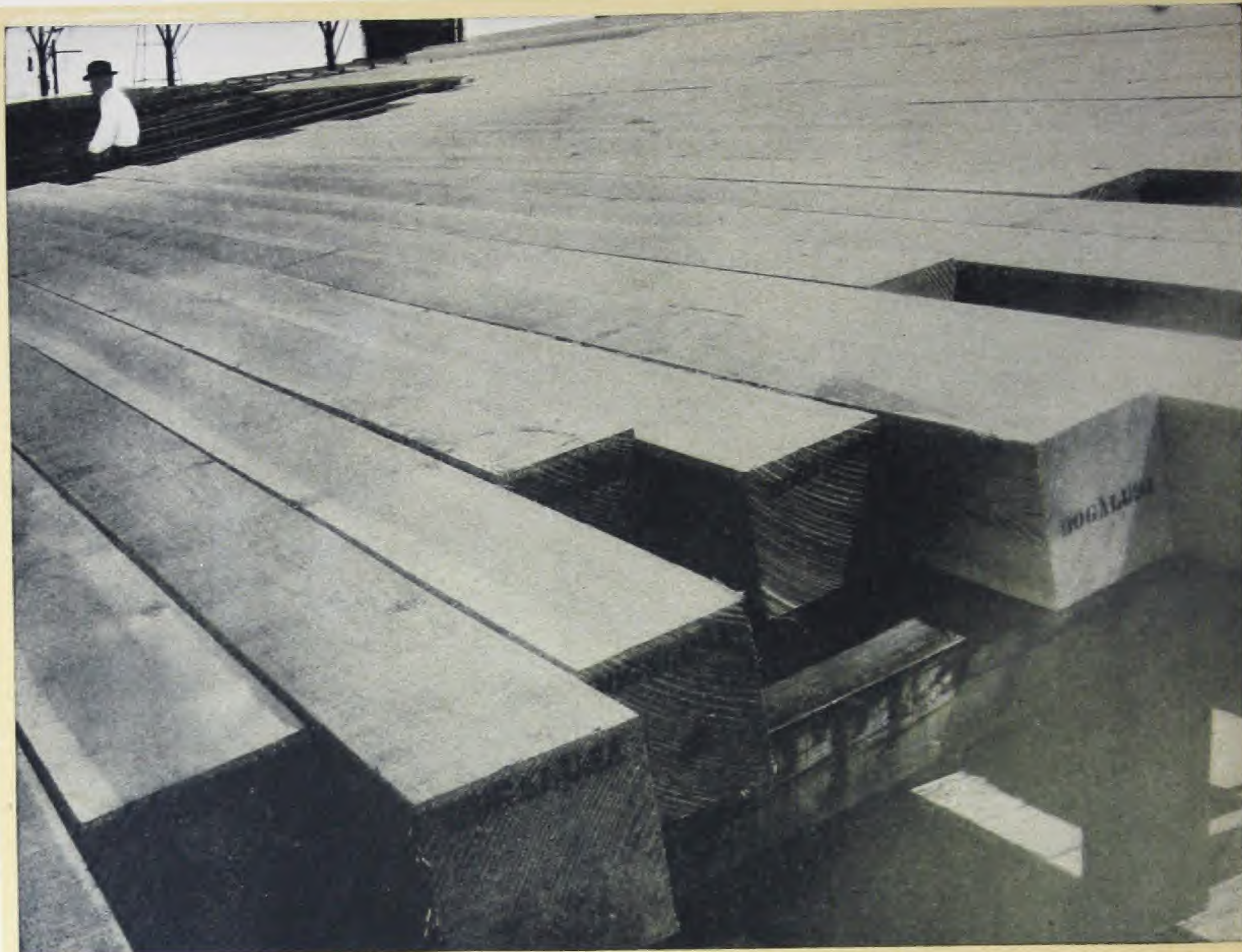
Merchantable Timbers.

Square Edge and Sound Timbers.

No. 1 Common Timbers.

Heart Timbers

All timber specifications, except "Merchantable," specifying heart requirements, shall be considered as a special contract.



The Term "Commercial Long Leaf" is Unknown at BOGALUSA. These Branded Sticks are Genuine Long Leaf Pine

Select Structural Material

(A rule incorporating suggestions by the United States Forest Service. Adopted by the American Society for Testing Materials, Aug. 21, 1915. Copyright, 1915, American Society for Testing Materials.)

REQUIREMENTS FOR DENSITY AND RATE OF GROWTH

1. Shall contain only sound wood and be well manufactured.
2. Shall conform to the definition of dense Southern pine as adopted by the American Society for Testing Materials, August 21st, 1915, as follows:

Dense southern yellow pine shall show on either end an average of at least six annular rings per inch and at least one-third summer wood, or else the greatest number of rings shall show at least one-third summer wood, all as measured over the third, fourth and fifth inches on a radial line from pith.

Wide-ringed material excluded by this rule, will be acceptable, provided the amount of summer wood, as above measured, shall be at least one-half.

The contrast in color between summer wood and spring wood shall be sharp and the summer wood shall be dark in color except in pieces having considerably above the minimum requirement for summer wood.

For the purpose of determining whether any given piece meets the requirements for density and rate of growth, the following rule, suggested by the United States Forest Service, shall be applied. It will be sufficient if either end passes the inspection.

(1) PITH PRESENT OR ACCURATELY LOCATED.

(A) Radial line of 5" present.

- (a) Apply inspection over third, fourth and fifth inches.

(B) Radial line of 5" not present.

Apply inspection to the second inch on 2x3, 2x4, 2x6, 3x3, 3x4, 4x4, or any other dimension material that has less than 16 square inches on the cross-section.

- (b) In the larger material apply inspection to the 3 inches farthest from the pith.



The Pine Tree Inn at BOGALUSA, Maintained for the Comfort of the Great Southern Lumber Company's Visitors

- (2) PITH NOT PRESENT OR CANNOT BE ACCURATELY LOCATED.
 - (A) Material over 3" thick, apply inspection to three inches nearest the pith.
 - (B) Dimension material 3" or less in thickness, apply inspection to second inch of the piece nearest the pith.
- (3) THE RADIAL LINE CHOSEN SHALL SHOW A REPRESENTATIVE NUMBER OF ANNUAL RINGS OF GROWTH AND PER CENT OF SUMMERWOOD.

DEFINITION FOR SOUTHERN YELLOW PINE

3. Southern Yellow Pine—This term includes the species of yellow pine growing in the Southern States from Virginia to Texas, that is, the pines hereto known as longleaf pine (*Pinus palustris*), shortleaf pine (*Pinus echinata*), loblolly pine (*Pinus taeda*), Cuban pine (*Pinus heterophylla*), and pond pine (*Pinus serotina*).

Under this heading two classes of timber are designated: (A) dense southern yellow pine and (B) sound southern yellow pine. It is understood that these two terms are descriptive of quality rather than of botanical species.

(a) Dense southern yellow pine shall show on either end an average of at least six annual rings per inch and at least one-third summer wood, or else the greater number of the rings shall show at least one-third summer wood, all as measured over the third, fourth and fifth inches on a radial line from the pith. Wide-ringed material excluded by this rule will be acceptable, provided that the amount of summer wood as above measured shall be at least one-half.

The contrast in color between summer wood and spring wood shall be sharp and the summer wood shall be dark in color, except in pieces having considerably above the minimum requirement for summer wood.

(b) Sound southern yellow pine shall include pieces of southern pine without any ring or summer wood requirement.

| | | |
|------------|------------|------------|
| | Volume 2 | 1/4 |
| | Volume 3 | 1/2 |
| | Volume 1 | 1/4 |
| 1/4 length | 1/2 length | 1/4 length |

RESTRICTIONS ON KNOTS IN BEAMS

4. Shall not have in Volume 1 sound knots greater in diameter than one-fourth the width of the face on which they appear—maximum knot 1 1/2". Shall not have in Volume 2 sound knots greater in diameter than one-half the width of the face on which they appear—maximum knot 3 inches.

The aggregate diameter of all knots within the center half of the length of any face shall not exceed the width of that face.

The diameter of a knot on the narrow or horizontal face of a beam is to be taken as its projection on a line perpendicular to the edge of the timber. On the wide or vertical face, the smallest dimension of a knot is to be taken as its diameter.



The Great Southern Lumber Company's Administrative Headquarters at BOGALUSA

RESTRICTIONS ON KNOTS IN COLUMNS

5. Shall not have sound knots greater in diameter than one-third the least width of the column—maximum knots 4 inches.

RESTRICTIONS ON SHAKES AND CHECKS IN BEAMS

6. Round or ring shakes shall not occupy, at either end of a timber, more than one-fourth the width of green material, nor more than one-third the width of seasoned material.

Any combination of checks and shakes which would reduce the strength to a greater extent than the allowable round shakes will not be permitted. Shakes shall not show on the faces of either green or seasoned timber.

RESTRICTIONS ON CROSS GRAIN IN BEAMS

Shall not have diagonal grain with slope greater than one in twenty in Volume 1.

Merchantable Timbers

May be either dense or sound pine.

All merchantable timbers shall be well manufactured and conform to the General Timber Specifications.

Sizes under 9" on the largest dimension shall show two-thirds or more heart surface on one of the wide faces; sizes 9" and over on the largest dimension shall show two-thirds or more heart on both of the wide faces. When sticks are square the face showing the most heart shall govern the inspection on sizes under 9", and the two faces showing the most heart shall govern the inspection when 9" and over. Heart showing the full length, even if not two-thirds of the area as above, shall meet the requirements of this quality.

Wane not exceeding one-eighth of the dimension of the face and one-quarter of the length of the piece on one corner, or the equivalent on two or more corners on not to exceed ten per cent of the pieces, shall be admitted.

Square Edge and Sound Timbers

May be either dense or sound pine.

Square edge and sound timbers shall be well manufactured and conform to the General Timber Specifications, admitting sound knots, and shall be free from wane.

No. 1 Common Timbers

May be either dense or sound pine.

Common timbers, rough 4x4 and larger, shall not be more than $\frac{1}{4}$ " scant at any point when green, and be well manufactured, and may have $1\frac{1}{2}$ " wane on one corner one-third the length of the piece, or its equivalent on two or more corners; the wane measured on its face.

Timbers 10x10 in size may have 2" wane as above; the larger sizes may have wane as above in proportion to sizes.

The diameter of any one knot shall not exceed 2" in 4x4 to 6x6; $2\frac{1}{2}$ " in 6x8 to 8x10; 3" in 10x10 to 10x12; $3\frac{1}{2}$ " in 12x12 to 12x14; 4" in 14x14 to 14x16; $4\frac{1}{2}$ " in 16x16 to 16x18. In sizes not mentioned the diameter of knots admissible will increase or decrease in proportion to the size of the timbers on same basis as above specified.

In determining the size of knots, mean or average diameter shall be taken, or the equivalent of the above in grouped knots at any one point. Shakes one-sixth the length of the piece, small unsound knots and a limited number of pin worm holes, well scattered, are admissible.

Standard Specifications for Southern Yellow Pine Bridge and Trestle Timbers*

(To be applied to single sticks and not to composite members.)

General Requirements

1. Except as noted, all timber shall be sound, sawed to standard size, full length, square cornered and straight; shall be close grained and free from defects such as injurious ring shakes and cross grain, unsound or loose knots, knots in groups, decay, or other defects that will materially impair its strength.

Standard Size

2. Rough timbers sawed to standard size means that they shall not be over one-fourth ($\frac{1}{4}$) in. scant from the actual size specified. For instance, a twelve by twelve (12x12) in. timber shall measure not less than eleven and three-fourths by eleven and three-fourths ($11\frac{3}{4} \times 11\frac{3}{4}$) in.

Standard Dressing

3. Standard dressing means that not more than one-fourth ($\frac{1}{4}$) in. shall be allowed for dressing each surface. For instance, a twelve by twelve (12x12) in. timber, after being dressed on four sides, shall measure not less than eleven and one-half by eleven and one-half ($11\frac{1}{2} \times 11\frac{1}{2}$) in.

STANDARD HEART GRADE, LONGLEAF YELLOW PINE

4. Stringers shall show not less than eight-five (85) per cent heart on the girth anywhere in the length of the piece; provided, however, that if the maximum amount of sap is shown on either narrow face of the stringer, the average depth of sap shall not exceed one-half ($\frac{1}{2}$) in. Knots greater than one and one-half ($1\frac{1}{2}$) in. in diameter will not be permitted at any section within four (4) in. of the edge of the piece, but knots shall in no case exceed four (4) in. in their largest diameter.

5. Caps and sills shall show not less than eighty-five (85) per cent heart on each of the four sides, measured across the sides anywhere in the length of the piece; to be free from knots over two and one-half ($2\frac{1}{2}$) in. in diameter.

6. Posts shall show not less than seventy-five (75) per cent heart on each of the four sides, measured across the sides anywhere in the length of the piece, and to be free from knots over two and one-half ($2\frac{1}{2}$) in. in diameter.

WOODEN BRIDGES AND TRESTLES

7. Longitudinal Struts and Girts. One side shall show all heart; the other side shall show not less than eighty-five (85) per cent heart, measured across the side anywhere in the length of the piece, and shall be free from any large knots or other defects that will materially injure its strength.

8. Longitudinal X Braces, Sash Braces and Sway Braces shall show four square corners and not less than eighty (80) per cent heart on each of two sides, and shall be free from any large knots or other defects that will materially injure their strength.

9. Ties and Guard Rails shall show one side all heart; the other side and two edges shall show not less than seventy-five (75) per cent heart, measured across the surface anywhere in the length of the piece; shall be free from any large knots or other defects that will materially injure its strength; and where surfaced the remaining rough face shall show all heart.

STANDARD GRADE, LONGLEAF AND SHORTLEAF YELLOW PINE

10. Stringers shall be square cornered, with the exception of one (1) in. wane on one corner or one-half ($\frac{1}{2}$) in. wane on two corners. Knots shall not exceed in their largest diameter one-fourth ($\frac{1}{4}$) of the width of the surface of the stick in which they occur, and shall in no case exceed four (4) in. Ring shakes shall not extend over one-eighth ($\frac{1}{8}$) of the length of the piece.

11. Caps and Sills shall be square cornered, with the exception of one (1) in. wane on one corner, or one-half ($\frac{1}{2}$) in. wane on two corners. Knots shall not exceed in their largest diameter one-fourth ($\frac{1}{4}$) of the width of the surface of the stick in which they occur, and in no case shall exceed four (4) in. Ring shakes shall not extend over one-eighth ($\frac{1}{8}$) of the length of the piece.

*Adopted by American Railway Engineering Association. See proceedings, Vol. 10, Part 1, 1909, pp. 537, 539-541, 598-603; Vol. 11, 1910, Part 1, pp. 176, 180, 181, 228-230. Association Manual, 1911 edition, pp. 141-143.

12. Posts shall be square cornered, with the exception of one (1) in. wane on one corner, or one-half ($\frac{1}{2}$) in wane on two corners. Knots shall not exceed, in their largest diameter, one-fourth ($\frac{1}{4}$) of the width of the surface of the stick in which they occur, and shall in no case exceed four (4) in. Ring shakes shall not extend over one-eighth ($\frac{1}{8}$) of the length of the piece.

13. Longitudinal Struts and Girts shall be square cornered and sound, and shall be free from any large knots or other defects that will materially injure their strength.

14. Longitudinal X Braces, Sash Braces and Sway Braces shall be square cornered and sound, and shall be free from any large knots or other defects that will materially injure their strength.

EXPLANATORY NOTE FOR STANDARD HEART GRADE

These specifications state the maximum limit of sap wood which will be accepted. In practice, with good inspection, the effect of these specifications should be to secure timber the bulk of which is practically all heart. In permanent bridge timber, not protected from decay, sapwood is not only useless in itself, but by furnishing a lodgment for the spores of fungi it is the cause of starting and promoting the continuance of rot in the heart. Sapwood, especially after decay has set in, is also extremely susceptible to fire, while with precautions ordinarily exercised heartwood is practically immune from this source of danger.

On the other hand, for ordinary commercial purposes sapwood is as valuable as heart. Therefore, if the mill owners understand what is wanted, good heart timber can be obtained for a small advance in price over what is usually furnished, much of which contains in bulk 50 per cent or more of sap wood.

To obtain proper results inspection should be made at the mills, where unsatisfactory timber can be rejected without hardship to the mill owner. Extensive buyers of timber should have inspectors stationed at the mills. To cover the needs of smaller buyers and municipalities, it seems that some of the established inspection companies might maintain an organization of timber inspectors at the mills, which would prove profitable to themselves, satisfactory to the mill owners and of incalculable benefit to those who use the timber.

Working Unit Stresses, Load Limits, etc. for Southern Yellow Pine

SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR SOUTHERN YELLOW PINE BEAMS LIMITED BY RESISTANCE TO HORIZONTAL SHEAR ALONG THE NEUTRAL AXIS

(Actual Size)

| Nominal Size | Actual Size | Horizontal Shearing Stress in Pounds per Square Inch | | | | | Nominal Size | Actual Size | Horizontal Shearing Stress in Pounds per Square Inch | | | | |
|----------------------|------------------------------------|--|-------|-------|-------|-------|---------------------|------------------------------------|--|-------|-------|-------|--------|
| | | 100 % | 125 % | 150 % | 175 % | 200 % | | | 100 % | 125 % | 150 % | 175 % | 200 % |
| 2 x 4 | 1 $\frac{5}{8}$ x 3 $\frac{5}{8}$ | 784 | 980 | 1176 | 1372 | 1568 | 2 x 14 | 1 $\frac{3}{4}$ x13 $\frac{1}{2}$ | 3150 | 3937 | 4725 | 5512 | 6300 |
| 4 x 4 | 3 $\frac{5}{8}$ x 3 $\frac{5}{8}$ | 1752 | 2190 | 2628 | 3066 | 3504 | 2 $\frac{1}{2}$ x14 | 2 $\frac{1}{4}$ x13 $\frac{1}{2}$ | 4050 | 5062 | 6075 | 7087 | 8100 |
| 4 x 4 | 3 $\frac{1}{2}$ x 3 $\frac{1}{2}$ | 1632 | 2040 | 2448 | 2856 | 3264 | 3 x 14 | 2 $\frac{3}{4}$ x13 $\frac{1}{2}$ | 4950 | 6187 | 7425 | 8662 | 9900 |
| 2 x 6 | 1 $\frac{5}{8}$ x 5 $\frac{5}{8}$ | 1220 | 1525 | 1830 | 2135 | 2440 | 4 x 14 | 3 $\frac{3}{4}$ x13 $\frac{1}{2}$ | 6750 | 8437 | 10125 | 11812 | 13500 |
| 2 $\frac{1}{2}$ x 6 | 2 $\frac{1}{4}$ x 5 $\frac{1}{2}$ | 1650 | 2062 | 2475 | 2887 | 3300 | 6 x 14 | 5 $\frac{1}{2}$ x13 $\frac{1}{2}$ | 9900 | 12375 | 14875 | 17325 | 19800 |
| 3 x 6 | 2 $\frac{3}{4}$ x 5 $\frac{1}{2}$ | 2016 | 2520 | 3024 | 3528 | 4032 | 8 x 14 | 7 $\frac{1}{2}$ x13 $\frac{1}{2}$ | 13500 | 16875 | 20250 | 23625 | 27000 |
| 4 x 6 | 3 $\frac{5}{8}$ x 5 $\frac{5}{8}$ | 2720 | 3400 | 4080 | 4760 | 5440 | 10 x 14 | 9 $\frac{1}{2}$ x13 $\frac{1}{2}$ | 17100 | 21375 | 25650 | 29925 | 34200 |
| 6 x 6 | 5 $\frac{1}{2}$ x 5 $\frac{1}{2}$ | 4032 | 5040 | 6048 | 7056 | 8064 | 12 x 14 | 11 $\frac{1}{2}$ x13 $\frac{1}{2}$ | 20700 | 25875 | 31050 | 36225 | 41400 |
| 2 x 8 | 1 $\frac{5}{8}$ x 7 $\frac{1}{2}$ | 1625 | 2031 | 2437 | 2843 | 3249 | 14 x 14 | 13 $\frac{1}{2}$ x13 $\frac{1}{2}$ | 24300 | 30375 | 36450 | 42525 | 48600 |
| 2 $\frac{1}{2}$ x 8 | 2 $\frac{1}{4}$ x 7 $\frac{1}{2}$ | 2250 | 2812 | 3375 | 3937 | 4500 | 2 x 16 | 1 $\frac{3}{4}$ x15 $\frac{1}{2}$ | 3616 | 4520 | 5424 | 6328 | 7232 |
| 3 x 8 | 2 $\frac{3}{4}$ x 7 $\frac{1}{2}$ | 2750 | 3437 | 4125 | 4812 | 5500 | 2 $\frac{1}{2}$ x16 | 2 $\frac{1}{4}$ x15 $\frac{1}{2}$ | 4650 | 5812 | 6975 | 8137 | 9300 |
| 4 x 8 | 3 $\frac{3}{4}$ x 7 $\frac{1}{2}$ | 3750 | 4687 | 5625 | 6562 | 7500 | 3 x 16 | 2 $\frac{3}{4}$ x15 $\frac{1}{2}$ | 5684 | 7105 | 8526 | 9947 | 11368 |
| 6 x 8 | 5 $\frac{1}{2}$ x 7 $\frac{1}{2}$ | 5500 | 6875 | 8250 | 9625 | 11000 | 4 x 16 | 3 $\frac{3}{4}$ x15 $\frac{1}{2}$ | 7750 | 9687 | 11625 | 13562 | 15500 |
| 8 x 8 | 7 $\frac{1}{2}$ x 7 $\frac{1}{2}$ | 7500 | 9375 | 11250 | 13125 | 15000 | 6 x 16 | 5 $\frac{1}{2}$ x15 $\frac{1}{2}$ | 11366 | 14207 | 17049 | 19890 | 22732 |
| 2 x 10 | 1 $\frac{5}{8}$ x 9 $\frac{1}{2}$ | 2058 | 2572 | 3087 | 3601 | 4116 | 8 x 16 | 7 $\frac{1}{2}$ x15 $\frac{1}{2}$ | 15500 | 19375 | 23250 | 27125 | 31000 |
| 2 $\frac{1}{2}$ x 10 | 2 $\frac{1}{4}$ x 9 $\frac{1}{2}$ | 2850 | 3562 | 4275 | 4987 | 5700 | 10 x 16 | 9 $\frac{1}{2}$ x15 $\frac{1}{2}$ | 19634 | 24542 | 29451 | 34359 | 39268 |
| 3 x 10 | 2 $\frac{3}{4}$ x 9 $\frac{1}{2}$ | 3484 | 4355 | 5226 | 6097 | 6968 | 12 x 16 | 11 $\frac{1}{2}$ x15 $\frac{1}{2}$ | 23766 | 29707 | 35649 | 41590 | 47532 |
| 4 x 10 | 3 $\frac{3}{4}$ x 9 $\frac{1}{2}$ | 4750 | 5937 | 7125 | 8312 | 9500 | 14 x 16 | 13 $\frac{1}{2}$ x15 $\frac{1}{2}$ | 27900 | 34875 | 41850 | 48825 | 55800 |
| 6 x 10 | 5 $\frac{1}{2}$ x 9 $\frac{1}{2}$ | 6966 | 8707 | 10449 | 12190 | 13932 | 16 x 16 | 15 $\frac{1}{2}$ x15 $\frac{1}{2}$ | 32032 | 40040 | 48048 | 56056 | 64064 |
| 8 x 10 | 7 $\frac{1}{2}$ x 9 $\frac{1}{2}$ | 9500 | 11875 | 14250 | 16625 | 19000 | 2 x 18 | 1 $\frac{3}{4}$ x17 $\frac{1}{2}$ | 4084 | 5105 | 6126 | 7147 | 8168 |
| 10 x 10 | 9 $\frac{1}{2}$ x 9 $\frac{1}{2}$ | 12032 | 15040 | 18048 | 21056 | 24064 | 2 $\frac{1}{2}$ x18 | 2 $\frac{1}{4}$ x17 $\frac{1}{2}$ | 5250 | 6562 | 7875 | 9187 | 10500 |
| 2 x 12 | 1 $\frac{5}{8}$ x11 $\frac{1}{2}$ | 2492 | 3115 | 3738 | 4361 | 4984 | 3 x 18 | 2 $\frac{3}{4}$ x17 $\frac{1}{2}$ | 6416 | 8020 | 9624 | 11228 | 12832 |
| 2 $\frac{1}{2}$ x 12 | 2 $\frac{1}{4}$ x11 $\frac{1}{2}$ | 3450 | 4312 | 5175 | 6037 | 6900 | 4 x 18 | 3 $\frac{3}{4}$ x17 $\frac{1}{2}$ | 8750 | 10937 | 13125 | 15312 | 17500 |
| 3 x 12 | 2 $\frac{3}{4}$ x11 $\frac{1}{2}$ | 4216 | 5270 | 6324 | 7378 | 8432 | 6 x 18 | 5 $\frac{1}{2}$ x17 $\frac{1}{2}$ | 12834 | 16042 | 19251 | 22459 | 25668 |
| 4 x 12 | 3 $\frac{3}{4}$ x11 $\frac{1}{2}$ | 5750 | 7187 | 8625 | 10062 | 11500 | 8 x 18 | 7 $\frac{1}{2}$ x17 $\frac{1}{2}$ | 17500 | 21875 | 26250 | 30625 | 35000 |
| 6 x 12 | 5 $\frac{1}{2}$ x11 $\frac{1}{2}$ | 8432 | 10540 | 12648 | 14756 | 16864 | 10 x 18 | 9 $\frac{1}{2}$ x17 $\frac{1}{2}$ | 22166 | 27707 | 33249 | 38790 | 44332 |
| 8 x 12 | 7 $\frac{1}{2}$ x11 $\frac{1}{2}$ | 11500 | 14375 | 17250 | 20125 | 23000 | 12 x 18 | 11 $\frac{1}{2}$ x17 $\frac{1}{2}$ | 26834 | 33542 | 40251 | 46959 | 53668 |
| 10 x 12 | 9 $\frac{1}{2}$ x11 $\frac{1}{2}$ | 14566 | 18207 | 21849 | 25490 | 29132 | 14 x 18 | 13 $\frac{1}{2}$ x17 $\frac{1}{2}$ | 31500 | 39375 | 47250 | 55125 | 63000 |
| 12 x 12 | 11 $\frac{1}{2}$ x11 $\frac{1}{2}$ | 17632 | 22040 | 26448 | 30856 | 35264 | 16 x 18 | 15 $\frac{1}{2}$ x17 $\frac{1}{2}$ | 36166 | 45207 | 54249 | 63290 | 72332 |
| | | | | | | | 18 x 18 | 17 $\frac{1}{2}$ x17 $\frac{1}{2}$ | 40832 | 51040 | 61248 | 71456 | 81664 |
| | | | | | | | 20 x 20 | 19 $\frac{1}{2}$ x19 $\frac{1}{2}$ | 50700 | 63375 | 76050 | 88725 | 101400 |

SOUTHERN YELLOW PINE POSTS

(Actual Size)

SAFE LOADS IN TONS OF 2000
POUNDS

SAFE STRENGTH IN POUNDS
PER INCH

For Various Values of l/d .

Square End Bearing and Symmetrically Loaded.

| Nom- inal Size Inches | Actual Size Inches | Area Sq. In. | l/d | Length in Feet | COMPRESSION PARALLEL TO THE GRAIN POUNDS PER SQ. IN. | | | | l/d | COMPRESSION PARALLEL TO THE GRAIN POUNDS PER SQUARE INCH | | | | | |
|--------------------------------|--------------------------|-----------------|-------|----------------------|--|--------|--------|--------|-------|---|------|------|------|------|------|
| | | | | | 1000 | 1100 | 1300 | 1500 | | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 |
| 6x 6 | 5½x 5½ | 30¼ | 17.5 | 8 | 11.82 | 13.00 | 15.36 | 17.72 | 5 | 938 | 1031 | 1125 | 1219 | 1312 | 1406 |
| 6x 6 | 5½x 5½ | 30¼ | 21.8 | 10 | 11.01 | 12.11 | 14.31 | 16.51 | 6 | 925 | 1017 | 1109 | 1202 | 1295 | 1387 |
| 6x 6 | 5½x 5½ | 30¼ | 26.2 | 12 | 10.18 | 11.19 | 13.23 | 15.27 | 7 | 913 | 1004 | 1095 | 1186 | 1277 | 1369 |
| 6x 6 | 5½x 5½ | 30¼ | 30.5 | 14 | 9.35 | 10.29 | 12.15 | 14.01 | 8 | 900 | 990 | 1080 | 1170 | 1260 | 1350 |
| | | | | | | | | | 9 | 887 | 975 | 1064 | 1153 | 1242 | 1331 |
| 8x 8 | 7½x 7½ | 56¼ | 12.8 | 8 | 23.64 | 26.00 | 30.73 | 35.45 | 10 | 875 | 962 | 1050 | 1137 | 1225 | 1312 |
| 8x 8 | 7½x 7½ | 56¼ | 16.0 | 10 | 22.50 | 24.75 | 29.25 | 33.75 | 11 | 862 | 948 | 1034 | 1120 | 1206 | 1292 |
| 8x 8 | 7½x 7½ | 56¼ | 19.2 | 12 | 21.37 | 23.51 | 27.79 | 32.07 | 12 | 850 | 935 | 1020 | 1105 | 1190 | 1275 |
| 8x 8 | 7½x 7½ | 56¼ | 22.4 | 14 | 20.25 | 22.27 | 26.31 | 30.35 | 13 | 837 | 921 | 1005 | 1089 | 1173 | 1257 |
| 8x 8 | 7½x 7½ | 56¼ | 25.6 | 16 | 19.12 | 21.03 | 24.85 | 28.67 | 14 | 825 | 907 | 990 | 1072 | 1155 | 1237 |
| 8x 8 | 7½x 7½ | 56¼ | 28.8 | 18 | 18.00 | 19.80 | 23.40 | 27.00 | | | | | | | |
| 8x 8 | 7½x 7½ | 56¼ | 32.0 | 20 | 16.87 | 18.56 | 21.94 | 25.32 | 15 | 812 | 893 | 974 | 1055 | 1136 | 1217 |
| 10x10 | 9½x 9½ | 90¼ | 10.1 | 8 | 39.42 | 43.36 | 51.24 | 59.13 | 16 | 800 | 880 | 960 | 1040 | 1120 | 1200 |
| 10x10 | 9½x 9½ | 90¼ | 12.6 | 10 | 38.03 | 41.83 | 49.43 | 57.05 | 17 | 787 | 866 | 945 | 1024 | 1103 | 1182 |
| 10x10 | 9½x 9½ | 90¼ | 15.2 | 12 | 36.55 | 40.20 | 47.51 | 54.82 | 18 | 775 | 853 | 930 | 1008 | 1085 | 1163 |
| 10x10 | 9½x 9½ | 90¼ | 17.7 | 14 | 35.20 | 38.72 | 45.76 | 52.80 | 19 | 762 | 838 | 914 | 990 | 1066 | 1142 |
| 10x10 | 9½x 9½ | 90¼ | 20.2 | 16 | 33.84 | 37.22 | 43.99 | 50.75 | 20 | 750 | 825 | 900 | 975 | 1050 | 1125 |
| 10x10 | 9½x 9½ | 90¼ | 22.7 | 18 | 32.32 | 35.55 | 42.01 | 48.48 | 21 | 737 | 811 | 885 | 958 | 1031 | 1105 |
| 10x10 | 9½x 9½ | 90¼ | 25.3 | 20 | 30.85 | 33.93 | 40.10 | 46.27 | 22 | 725 | 798 | 870 | 943 | 1015 | 1088 |
| 12x12 | 11½x 11½ | 132¼ | 8.3 | 8 | 59.51 | 65.46 | 77.36 | 89.26 | 23 | 712 | 784 | 855 | 926 | 997 | 1068 |
| 12x12 | 11½x 11½ | 132¼ | 10.4 | 10 | 57.53 | 63.28 | 74.78 | 86.29 | 24 | 700 | 770 | 840 | 910 | 980 | 1050 |
| 12x12 | 11½x 11½ | 132¼ | 12.5 | 12 | 55.78 | 61.36 | 72.52 | 83.68 | | | | | | | |
| 12x12 | 11½x 11½ | 132¼ | 14.6 | 14 | 54.10 | 59.51 | 70.33 | 81.15 | 25 | 687 | 756 | 824 | 893 | 961 | 1030 |
| 12x12 | 11½x 11½ | 132¼ | 16.7 | 16 | 52.24 | 57.46 | 67.91 | 78.35 | 26 | 675 | 743 | 810 | 878 | 945 | 1013 |
| 12x12 | 11½x 11½ | 132¼ | 18.8 | 18 | 50.58 | 55.64 | 65.76 | 75.88 | 27 | 662 | 728 | 794 | 860 | 926 | 992 |
| 12x12 | 11½x 11½ | 132¼ | 20.9 | 20 | 48.93 | 53.82 | 63.60 | 73.39 | 28 | 650 | 715 | 780 | 845 | 910 | 975 |
| 14x14 | 13½x 13½ | 182¼ | 7.1 | 8 | 82.93 | 91.22 | 107.80 | 124.39 | 29 | 637 | 701 | 765 | 829 | 893 | 957 |
| 14x14 | 13½x 13½ | 182¼ | 8.9 | 10 | 81.10 | 89.21 | 105.43 | 121.65 | 30 | 625 | 687 | 750 | 812 | 875 | 937 |
| 14x14 | 13½x 13½ | 182¼ | 10.7 | 12 | 79.27 | 87.20 | 103.06 | 118.91 | | | | | | | |
| 14x14 | 13½x 13½ | 182¼ | 12.4 | 14 | 76.96 | 84.65 | 100.04 | 115.43 | | | | | | | |
| 14x14 | 13½x 13½ | 182¼ | 14.2 | 16 | 74.97 | 82.46 | 97.46 | 112.46 | | | | | | | |
| 14x14 | 13½x 13½ | 182¼ | 16.0 | 18 | 72.90 | 80.19 | 94.77 | 109.35 | | | | | | | |
| 14x14 | 13½x 13½ | 182¼ | 17.8 | 20 | 71.07 | 78.18 | 92.40 | 106.62 | | | | | | | |
| 16x16 | 15½x 15½ | 240¼ | 6.2 | 8 | 110.84 | 121.92 | 144.09 | 166.25 | | | | | | | |
| 16x16 | 15½x 15½ | 240¼ | 7.7 | 10 | 109.00 | 119.90 | 141.70 | 163.50 | | | | | | | |
| 16x16 | 15½x 15½ | 240¼ | 9.3 | 12 | 106.15 | 116.76 | 137.99 | 159.22 | | | | | | | |
| 16x16 | 15½x 15½ | 240¼ | 10.8 | 14 | 103.86 | 114.24 | 135.01 | 155.78 | | | | | | | |
| 16x16 | 15½x 15½ | 240¼ | 12.4 | 16 | 101.44 | 111.58 | 131.87 | 152.15 | | | | | | | |
| 16x16 | 15½x 15½ | 240¼ | 14.0 | 18 | 99.05 | 108.95 | 128.76 | 148.57 | | | | | | | |
| 16x16 | 15½x 15½ | 240¼ | 15.5 | 20 | 96.86 | 106.55 | 125.92 | 145.29 | | | | | | | |
| 18x18 | 17½x 17½ | 306¼ | 5.5 | 8 | 142.55 | 156.80 | 185.31 | 213.82 | | | | | | | |
| 18x18 | 17½x 17½ | 306¼ | 6.9 | 10 | 139.90 | 153.89 | 181.87 | 209.85 | | | | | | | |
| 18x18 | 17½x 17½ | 306¼ | 8.2 | 12 | 137.54 | 151.29 | 178.80 | 206.31 | | | | | | | |
| 18x18 | 17½x 17½ | 306¼ | 9.6 | 14 | 134.75 | 148.22 | 175.17 | 202.12 | | | | | | | |
| 18x18 | 17½x 17½ | 306¼ | 11.0 | 16 | 132.11 | 145.32 | 171.74 | 198.16 | | | | | | | |
| 18x18 | 17½x 17½ | 306¼ | 12.3 | 18 | 129.74 | 142.71 | 168.66 | 194.60 | | | | | | | |
| 18x18 | 17½x 17½ | 306¼ | 13.7 | 20 | 127.09 | 139.80 | 165.22 | 190.64 | | | | | | | |

FORMULA

Unit strength per square inch = $C (1 - l/80d)$
 C = compressive strength per square inch with the grain.
 l = length of post in inches.
 d = least diameter in inches.

**PROPERTIES AND MAXIMUM BENDING MOMENTS (IN FOOT POUNDS) FOR
SOUTHERN YELLOW PINE BEAMS**

| Nom- inal Size | Actual Size | Dressed | Area of Section Sq. Ins. | Weight per Foot Pounds | Moment of Inertia Inches | Section Modulus Inches | Coefficient of Deflection Uniform Load Inches | MAXIMUM BENDING MOMENT IN FOOT LBS. | | | |
|----------------------|-----------------|---------|--------------------------------|---------------------------------|-----------------------------------|------------------------------|--|---|---|---|---|
| | | | | | | | | Fibre Stress 1200 # Per Sq. In. | Fibre Stress 1300 # Per Sq. In. | Fibre Stress 1500 # Per Sq. In. | Fibre Stress 1800 # Per Sq. In. |
| 2 x 4 | 1 5/8 x 3 5/8 | S1S1E | 5.89 | 1.63 | 6.45 | 3.56 | .0021533 | 356 | 385 | 444 | 534 |
| 4 x 4 | 3 5/8 x 3 5/8 | S1S1E | 13.14 | 3.64 | 14.39 | 7.94 | .0009652 | 794 | 860 | 992 | 1190 |
| 4 x 4 | 3 1/2 x 3 1/2 | S4S | 12.25 | 3.40 | 12.50 | 7.15 | .0011106 | 715 | 774 | 893 | 1072 |
| 2 x 6 | 1 5/8 x 5 5/8 | S1S1E | 9.14 | 2.53 | 24.10 | 8.57 | .0005763 | 857 | 928 | 1071 | 1285 |
| 2 1/2 x 6 | 2 1/4 x 5 1/2 | S1S1E | 12.37 | 3.43 | 31.18 | 11.34 | .0006078 | 1134 | 1228 | 1417 | 1701 |
| 3 x 6 | 2 3/4 x 5 1/2 | S1S1E | 15.12 | 4.20 | 38.13 | 13.86 | .0003643 | 1386 | 1501 | 1732 | 2079 |
| 4 x 6 | 3 5/8 x 5 5/8 | S1S1E | 20.39 | 5.65 | 53.76 | 19.12 | .0002583 | 1912 | 2071 | 2390 | 2868 |
| 6 x 6 | 5 1/2 x 5 1/2 | S4S | 30.25 | 8.38 | 76.25 | 27.73 | .0001821 | 2773 | 3004 | 3466 | 4159 |
| 2 x 8 | 1 5/8 x 7 1/2 | S1S1E | 12.19 | 3.38 | 57.13 | 15.23 | .0002431 | 1523 | 1650 | 1904 | 2284 |
| 2 1/2 x 8 | 2 1/4 x 7 1/2 | S1S1E | 16.87 | 4.68 | 79.10 | 21.10 | .0001756 | 2110 | 2285 | 2637 | 3165 |
| 3 x 8 | 2 3/4 x 7 1/2 | S1S1E | 20.62 | 5.72 | 96.68 | 25.78 | .0001437 | 2578 | 2793 | 3222 | 3867 |
| 4 x 8 | 3 3/4 x 7 1/2 | S1S1E | 28.12 | 7.80 | 131.83 | 35.16 | .00010535 | 3516 | 3809 | 4395 | 5174 |
| 6 x 8 | 5 1/2 x 7 1/2 | S1S1E | 41.25 | 11.43 | 193.36 | 51.56 | .00007183 | 5156 | 5585 | 6445 | 7734 |
| 8 x 8 | 7 1/2 x 7 1/2 | S4S | 56.25 | 15.58 | 263.67 | 70.31 | .00005268 | 7031 | 7616 | 8787 | 10545 |
| 2 x 10 | 1 5/8 x 9 1/4 | S1S1E | 15.44 | 4.28 | 116.10 | 24.44 | .0001197 | 2444 | 2648 | 3055 | 3666 |
| 2 1/2 x 10 | 2 1/4 x 9 1/2 | S1S1E | 21.37 | 5.92 | 160.76 | 33.84 | .0000864 | 3384 | 3666 | 4230 | 5076 |
| 3 x 10 | 2 3/4 x 9 1/2 | S1S1E | 26.12 | 7.24 | 196.48 | 41.36 | .00007069 | 4136 | 4480 | 5170 | 6204 |
| 4 x 10 | 3 3/4 x 9 1/2 | S1S1E | 35.62 | 9.87 | 267.93 | 56.41 | .00005184 | 5641 | 6110 | 7050 | 8461 |
| 6 x 10 | 5 1/2 x 9 1/2 | S4S | 52.25 | 14.47 | 392.96 | 82.73 | .00003534 | 8273 | 8962 | 10341 | 12409 |
| 8 x 10 | 7 1/2 x 9 1/2 | S4S | 71.25 | 19.74 | 535.86 | 112.81 | .00002592 | 11281 | 12221 | 14100 | 16921 |
| 10 x 10 | 9 1/2 x 9 1/2 | S4S | 90.25 | 25.00 | 678.75 | 142.89 | .00002046 | 14289 | 15480 | 17862 | 21435 |
| 2 x 12 | 1 5/8 x 11 1/2 | S1S1E | 18.69 | 5.18 | 205.95 | 35.82 | .00006744 | 3582 | 3880 | 4477 | 5373 |
| 2 1/2 x 12 | 2 1/4 x 11 1/2 | S1S1E | 25.87 | 7.17 | 285.16 | 49.59 | .00004871 | 4958 | 5371 | 6197 | 7436 |
| 3 x 12 | 2 3/4 x 11 1/2 | S1S1E | 31.62 | 8.76 | 348.53 | 60.61 | .00003985 | 6060 | 6565 | 7575 | 9090 |
| 4 x 12 | 3 3/4 x 11 1/2 | S1S1E | 43.12 | 11.95 | 475.27 | 82.66 | .00002922 | 8266 | 8955 | 10332 | 12399 |
| 6 x 12 | 5 1/2 x 11 1/2 | S4S | 63.25 | 17.52 | 697.07 | 121.23 | .00001993 | 12123 | 13133 | 15153 | 18185 |
| 8 x 12 | 7 1/2 x 11 1/2 | S4S | 86.25 | 23.89 | 950.55 | 165.31 | .00001461 | 16531 | 17908 | 20664 | 24796 |
| 10 x 12 | 9 1/2 x 11 1/2 | S4S | 109.25 | 30.26 | 1204.03 | 209.39 | .00001154 | 20939 | 22683 | 29174 | 31408 |
| 12 x 12 | 11 1/2 x 11 1/2 | S4S | 132.25 | 36.63 | 1457.51 | 253.48 | .00000953 | 25348 | 27460 | 31684 | 38020 |
| 2 x 14 | 1 3/4 x 13 1/2 | S1S1E | 23.62 | 6.55 | 358.80 | 53.16 | .00003871 | 5316 | 5759 | 6645 | 7974 |
| 2 1/2 x 14 | 2 1/4 x 13 1/2 | S1S1E | 30.37 | 8.41 | 461.32 | 68.34 | .00003011 | 6834 | 7403 | 8542 | 10251 |
| 3 x 14 | 2 3/4 x 13 1/2 | S1S1E | 37.12 | 10.28 | 563.84 | 83.53 | .00002463 | 8353 | 9049 | 10441 | 12529 |
| 4 x 14 | 3 3/4 x 13 1/2 | S1S1E | 50.62 | 14.02 | 768.87 | 113.91 | .00001806 | 11391 | 12340 | 14238 | 17086 |
| 6 x 14 | 5 1/2 x 13 1/2 | S4S | 74.25 | 20.57 | 1155.17 | 167.10 | .00001232 | 16710 | 18102 | 20887 | 25065 |
| 8 x 14 | 7 1/2 x 13 1/2 | S4S | 101.25 | 28.05 | 1537.73 | 227.81 | .00000903 | 22781 | 24679 | 28476 | 34174 |
| 10 x 14 | 9 1/2 x 13 1/2 | S4S | 128.25 | 35.53 | 1947.80 | 288.56 | .00000713 | 28856 | 31261 | 36071 | 43284 |
| 12 x 14 | 11 1/2 x 13 1/2 | S4S | 155.25 | 43.00 | 2357.86 | 349.31 | .00000589 | 34931 | 37841 | 43664 | 52396 |
| 14 x 14 | 13 1/2 x 13 1/2 | S4S | 182.25 | 50.48 | 2767.92 | 410.06 | .00000502 | 41006 | 44423 | 51257 | 61508 |
| 2 x 16 | 1 3/4 x 15 1/2 | S1S1E | 27.12 | 7.51 | 543.06 | 70.10 | .00002557 | 7010 | 7594 | 8762 | 10515 |
| 2 1/2 x 16 | 2 1/4 x 15 1/2 | S1S1E | 34.87 | 9.66 | 698.23 | 90.10 | .00001989 | 9010 | 9760 | 11262 | 13515 |
| 3 x 16 | 2 3/4 x 15 1/2 | S1S1E | 42.62 | 11.81 | 853.39 | 110.11 | .00001628 | 11011 | 11928 | 13763 | 16516 |
| 4 x 16 | 3 3/4 x 15 1/2 | S1S1E | 58.12 | 16.10 | 1163.71 | 150.16 | .00001193 | 15016 | 16267 | 18770 | 22524 |
| 6 x 16 | 5 1/2 x 15 1/2 | S4S | 85.25 | 23.61 | 1706.78 | 220.23 | .00000814 | 22023 | 23858 | 27528 | 33033 |
| 8 x 16 | 7 1/2 x 15 1/2 | S4S | 116.25 | 32.20 | 2327.42 | 300.31 | .00000597 | 30031 | 32533 | 37538 | 45046 |
| 10 x 16 | 9 1/2 x 15 1/2 | S4S | 147.25 | 40.79 | 2948.07 | 380.39 | .00000471 | 38039 | 41208 | 47548 | 57058 |
| 12 x 16 | 11 1/2 x 15 1/2 | S4S | 178.25 | 49.37 | 3568.71 | 460.48 | .00000389 | 46048 | 49885 | 57560 | 69072 |
| 14 x 16 | 13 1/2 x 15 1/2 | S4S | 209.25 | 57.96 | 4189.36 | 540.56 | .00000332 | 54056 | 58560 | 67569 | 81084 |
| 16 x 16 | 15 1/2 x 15 1/2 | S4S | 240.25 | 66.55 | 4810.00 | 620.65 | .00000289 | 62065 | 67237 | 77581 | 93097 |
| 2 x 18 | 1 3/4 x 17 1/2 | S1S1E | 30.62 | 8.48 | 781.57 | 89.32 | .00001777 | 8932 | 9676 | 11165 | 13398 |
| 2 1/2 x 18 | 2 1/4 x 17 1/2 | S1S1E | 39.37 | 10.91 | 1004.88 | 114.84 | .00001382 | 11484 | 12441 | 14355 | 17226 |
| 3 x 18 | 2 3/4 x 17 1/2 | S1S1E | 48.12 | 13.33 | 1228.19 | 140.36 | .00001131 | 14036 | 15205 | 17545 | 21054 |
| 4 x 18 | 3 3/4 x 17 1/2 | S1S1E | 65.62 | 18.18 | 1674.80 | 191.41 | .00000829 | 19141 | 20736 | 23926 | 28711 |
| 6 x 18 | 5 1/2 x 17 1/2 | S4S | 96.25 | 26.66 | 2456.38 | 280.73 | .00000565 | 28073 | 30412 | 35091 | 42109 |
| 8 x 18 | 7 1/2 x 17 1/2 | S4S | 131.25 | 36.36 | 3349.61 | 382.81 | .00000415 | 38281 | 41471 | 47850 | 57421 |
| 10 x 18 | 9 1/2 x 17 1/2 | S4S | 166.25 | 46.05 | 4242.84 | 484.89 | .00000327 | 48489 | 52530 | 60612 | 72734 |
| 12 x 18 | 11 1/2 x 17 1/2 | S4S | 201.25 | 55.75 | 5136.07 | 586.98 | .00000270 | 58698 | 63590 | 73373 | 88047 |
| 14 x 18 | 13 1/2 x 17 1/2 | S4S | 236.25 | 65.44 | 6029.29 | 689.06 | .00000230 | 68906 | 74648 | 86133 | 103359 |
| 16 x 18 | 15 1/2 x 17 1/2 | S4S | 271.25 | 75.14 | 6922.53 | 791.14 | .00000201 | 79114 | 85706 | 98892 | 118671 |
| 18 x 18 | 17 1/2 x 17 1/2 | S4S | 306.25 | 84.83 | 7815.76 | 893.23 | .00000178 | 89322 | 96765 | 111652 | 133982 |
| 20 x 20 | 19 1/2 x 19 1/2 | S4S | 380.25 | 105.33 | 12049.17 | 1235.81 | .00000115 | 123580 | 133878 | 154475 | 185370 |

"Actual size" indicates the size of the dressed timber and dressed as indicated. "S1S1E" indicates that the piece is "dressed on one side and one edge." "S4S" indicates that the piece is "dressed on four sides."

The weight of the section is based on a weight of 40 pounds per cubic foot.

The moment of inertia and section modulus are with the neutral axis perpendicular to the depth at the center.

The coefficient of deflection is the deflection in inches of a beam one foot long with a uniformly distributed load of 1,000 pounds. The deflection of a beam of any span and uniform load is obtained by multiplying the proper coefficient by the cube of the span in feet and by the number of 1,000-pound units in given load. For a concentrated load of 1,000 pounds applied at the center of the span the coefficient for such loading is 1.6 times the given coefficient. For a load of 1,000 pounds applied at the third points of the span in 500 pound units the coefficient for such loading is 1.36 times the given coefficient.

WOODEN BRIDGES AND TRESTLES*

WORKING UNIT-STRESSES FOR STRUCTURAL TIMBER USED IN WOODEN BRIDGES AND TRESTLES †

[Expressed In Pounds Per Square Inch.]

| KIND OF TIMBER | BENDING | | | SHEARING | | | | COMPRESSION | | | | | | Ratio of Length of Strin- ger to Depth |
|-----------------|----------------------------|-------------------|-------------------------------|--------------------------|-------------------|-------------------------------------|-------------------|------------------------------------|-------------------|--------------------------|-------------------|---|--|---|
| | Extreme Fibre Stress | | Modulus of Elas- ticity | Parallel to the Grain | | Longitud- inal Shear in Beams | | Perpen- dicular to the Grain | | Parallel to the Grain | | For Columns under 15 Diam. Work- ing Stress | Formulas for Work- ing Stress in Long Columns over 15 Diameters | |
| | Average Ultimate | Working Stress | | Average Ultimate | Working Stress | Average Ultimate | Working Stress | Elastic Limit | Working Stress | Average Ultimate | Working Stress | | | |
| Longleaf Pine | 6500 | 1300 | 1 610 000 | 720 | 180 | 300 | 120 | 520 | 260 | 3800 | 1300 | 980 | 1300(1— <i>l</i> /60 <i>d</i>) | 10 |
| Douglas Fir | 6100 | 1200 | 1 510 000 | 690 | 170 | 270 | 110 | 630 | 310 | 3600 | 1200 | 900 | 1200(1— <i>l</i> /60 <i>d</i>) | 10 |
| Shortleaf Pine | 5600 | 1100 | 1 480 000 | 710 | 170 | 330 | 130 | 340 | 170 | 3400 | 1100 | 830 | 1100(1— <i>l</i> /60 <i>d</i>) | 10 |
| White Pine | 4400 | 900 | 1 130 000 | 400 | 100 | 180 | 70 | 290 | 150 | 3000 | 1000 | 750 | 1000(1— <i>l</i> /60 <i>d</i>) | 10 |
| Spruce | 4800 | 1000 | 1 310 000 | 600 | 150 | 170 | 70 | 370 | 180 | 3200 | 1100 | 830 | 1100(1— <i>l</i> /60 <i>d</i>) | |
| Norway Pine | 4200 | 800 | 1 190 000 | ‡590 | 130 | 250 | 100 | — | 150 | ‡2600 | 800 | 600 | 800(1— <i>l</i> /60 <i>d</i>) | |
| Tamarack | 4600 | 900 | 1 220 000 | 670 | 170 | 260 | 100 | — | 220 | ‡3200 | 1000 | 750 | 1000(1— <i>l</i> /60 <i>d</i>) | |
| Western Hemlock | 5800 | 1100 | 1 480 000 | 630 | 160 | ‡270 | 100 | 440 | 220 | 3500 | 1200 | 900 | 1200(1— <i>l</i> /60 <i>d</i>) | |
| Redwood | 5000 | 900 | 800 000 | 300 | 80 | — | — | 400 | 150 | 3300 | 900 | 680 | 900(1— <i>l</i> /60 <i>d</i>) | |
| Bald Cypress | 4800 | 900 | 1 150 000 | 500 | 120 | — | — | 340 | 170 | 3900 | 1100 | 830 | 1100(1— <i>l</i> /60 <i>d</i>) | |
| Red Cedar | 4200 | 800 | 800 000 | — | — | — | — | 470 | 230 | 2800 | 900 | 680 | 900(1— <i>l</i> /60 <i>d</i>) | |
| White Oak | 5700 | 1100 | 1 150 000 | 840 | 210 | 270 | 110 | 920 | 450 | 3500 | 1300 | 980 | 1300(1— <i>l</i> /60 <i>d</i>) | 12 |

*—Adopted by American Railway Engineering Association, 1909. See association proceedings, Vol. 10, pp. 537, 564, 609-611.

These unit-stresses are for a green condition of timber and are to be used without increasing the live load stresses for impact.

†—Green Timber in Exposed Work.

‡—Partially air-dry.

l—Length in inches.

d—Least side in inches.

NOTE.—The working unit-stresses given in this table are intended for railroad bridges and trestles. For highway bridges and trestles the unit-stresses may be increased twenty-five (25) per cent. For buildings and similar structures, in which the timber is protected from the weather and practically free from impact, the unit-stresses may be increased fifty (50) per cent. To compute the deflection of a beam under long-continued loading instead of that when the load is first applied, only fifty (50) per cent of the corresponding modulus of elasticity given in the table is to be employed.

A VISUAL METHOD OF DISTINGUISHING LONGLEAF PINE*

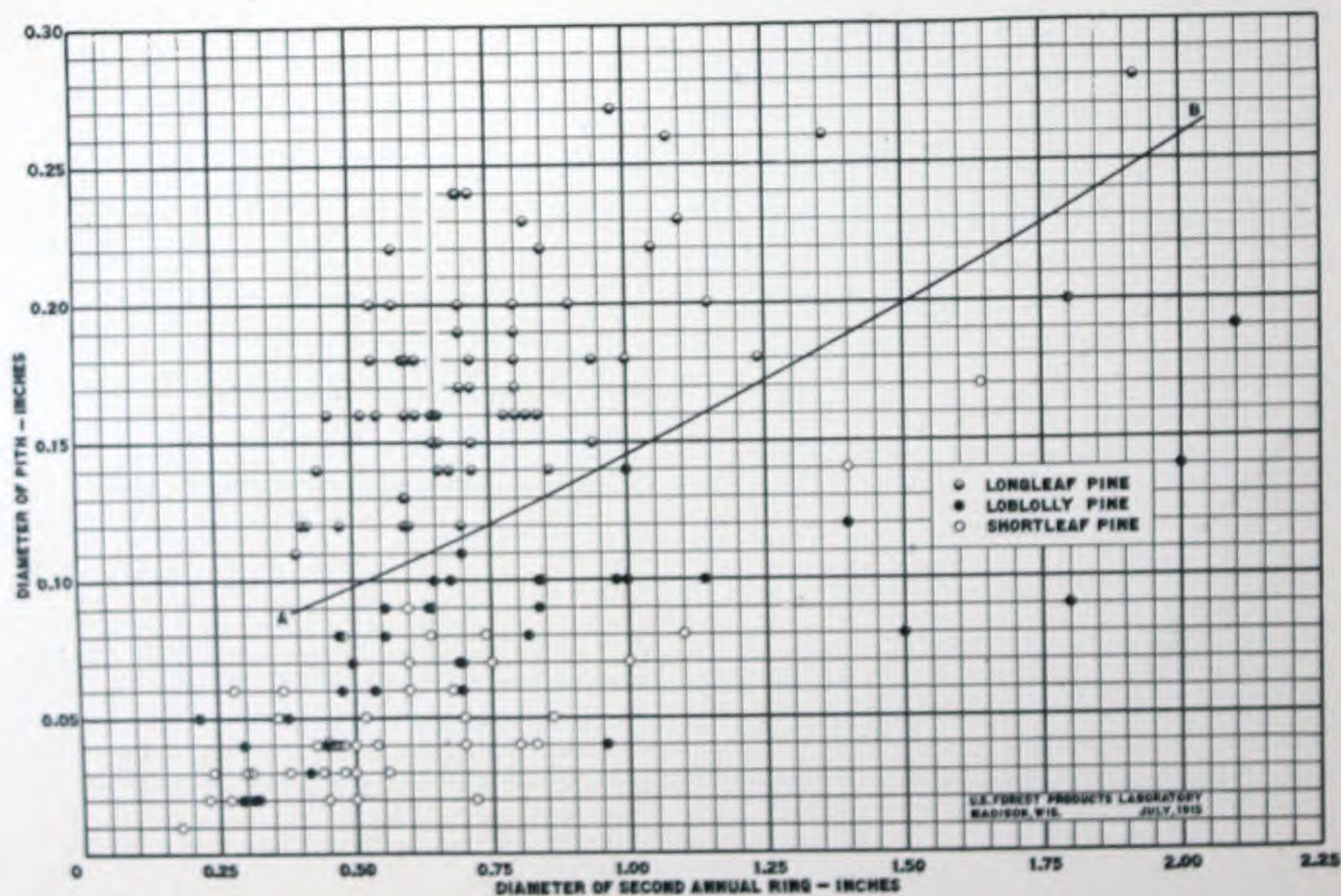
By Arthur Koehler, Expert in Wood Identification,
Forest Products Laboratory, U. S. Forest Service, Madison, Wis.

A detailed study of the wood of longleaf (*Pinus palustris*), loblolly (*Pinus taeda*), and shortleaf (*Pinus echinata*) pines has recently been made at the Forest Products Laboratory, Madison, Wis., for the purpose of determining if differences could be found by which the botanical species can always be distinguished. Previously no absolutely reliable means of identification had been known. A number of characteristic features were discovered in each species and, as far as observations have been made, they bid fair to distinguish positively between the species. Although the grading of structural timbers has lately been placed on a basis of density (shown by rate of growth and percent of summerwood), irrespective of species, yet it is often desirable to know the botanical name of a specimen.

SIZE OF PITH AND OF SECOND ANNUAL RING

Of chief interest to lumbermen is a difference in the size of the pith of these pines, because this feature can be observed without a microscope.

The pith of longleaf has been found to be over 0.10 inch in diameter in all normal specimens examined while in loblolly and shortleaf it was found to be less, except in specimens of vigorous growth. The vigor of the tree at the time the pith was formed in any part of the stem is indicated



5333M

FIG. 1.—RELATION OF DIAMETER OF PITH TO DIAMETER OF SECOND ANNUAL RING IN EACH SPECIES

*An article that appeared in the AMERICAN LUMBERMAN (Chicago) and the ENGINEERING RECORD (New York) September 11, 1915. The test here described applied to BOGALUSA BRAND STRUCTURAL TIMBERS will invariably demonstrate that they are GENUINE LONG LEAF PINE.

by the diameter of the first few annual rings surrounding the pith at that point. Therefore it was found that by taking the diameter of the second annual ring into consideration, together with the diameter of the pith, longleaf can also be separated from shortleaf and loblolly even when the latter have a pith over 0.10 inch in diameter. So far no exceptions have been found to the rule.

The illustrated diagram herewith (Fig. 1) shows the diameter of the pith of each species plotted against the diameter of the second annual ring. Each circle represents a separate tree. From the diagram it will be seen that whenever the pith in loblolly or shortleaf was found to be over 0.10 inch in diameter the diameter of the second annual ring was considerably larger than that found in longleaf having the same sized pith. The line (AB) was drawn so that those points that fall above the line represent longleaf and those that fall below it represent loblolly or shortleaf.



Fig. 2.—Transverse surface of a piece of longleaf pine showing pith (P), limit of second annual ring (A.R.), and leaf-trace (L.T.). Natural size.

In longleaf, even in slow-growing specimens, the first annual ring is comparatively large (see Fig. 3). This is evident from the fact that the yearly shoots are nearly always coarser in this species than in loblolly and shortleaf. Therefore, in specimens having a pith 0.11 inch or a little more in diameter the first annual ring of shortleaf or loblolly (fairly rapid growth) is only slightly larger than the first annual ring of longleaf (slow growth). The second annual ring in such specimens, however, is quite narrow in longleaf and fairly wide in the other two species, thus adding to the degree of separation. (It will be noticed that the diameter of the second annual ring includes the first also and is not the difference between the two.) Rings farther out were not considered, because they do not indicate as well the vigor of the tree at the time the pith was formed.

A careful analysis of the data obtained shows that out of 127 specimens of longleaf, representing eighty-three different trees, no pith was found less than 0.11 inches in diameter except in two specimens that were cut at a point where a whorl of branches joined the stem. Out of 110 specimens of shortleaf, representing sixty-six different trees, only fifteen had a pith over 0.10 inches in diameter. Out of sixty-four specimens of loblolly, representing forty-seven different trees, twenty had a pith over 0.10 inches in diameter. Usually the pith in shortleaf and slow-growing loblolly was about 0.08 inch or a little less in diameter. (The "lead" in an ordinary lead pencil is about 0.08 or 0.09 inch in diameter and can be used for comparison.) In general the pith is smallest at the stump, becomes rapidly larger upward and decreases again in the crown. All of the specimens studied were botanically identified by the leaves or cones.



Fig. 3.—Longleaf pine—a, slow; b, medium; c, rapid growth near center; x, second annual ring. Actual size.

HOW TO MEASURE PITH AND SECOND ANNUAL RING

The pith of the pines can be readily recognized as a small, darker and softer core in the structural center of the stem. The second annual ring is clearly defined by a distinct darker line (see Fig. 2), but sometimes the first annual ring is rather faint, and care must be taken not to mistake the third annual ring for the second. Occasionally dark bands, or false rings, are found in the wood (see first and second rings of Fig. 4), but these can be distinguished from true annual rings by the fact that their outer limit is not defined by a sharp line as is always the case with true annual rings. Measurements made on a section where knots join the center of the stem are not reliable for identification. At such points the pith may be unusually small or the rings irregular and the other end of the specimen should be examined. To measure the pith and second annual ring properly it is

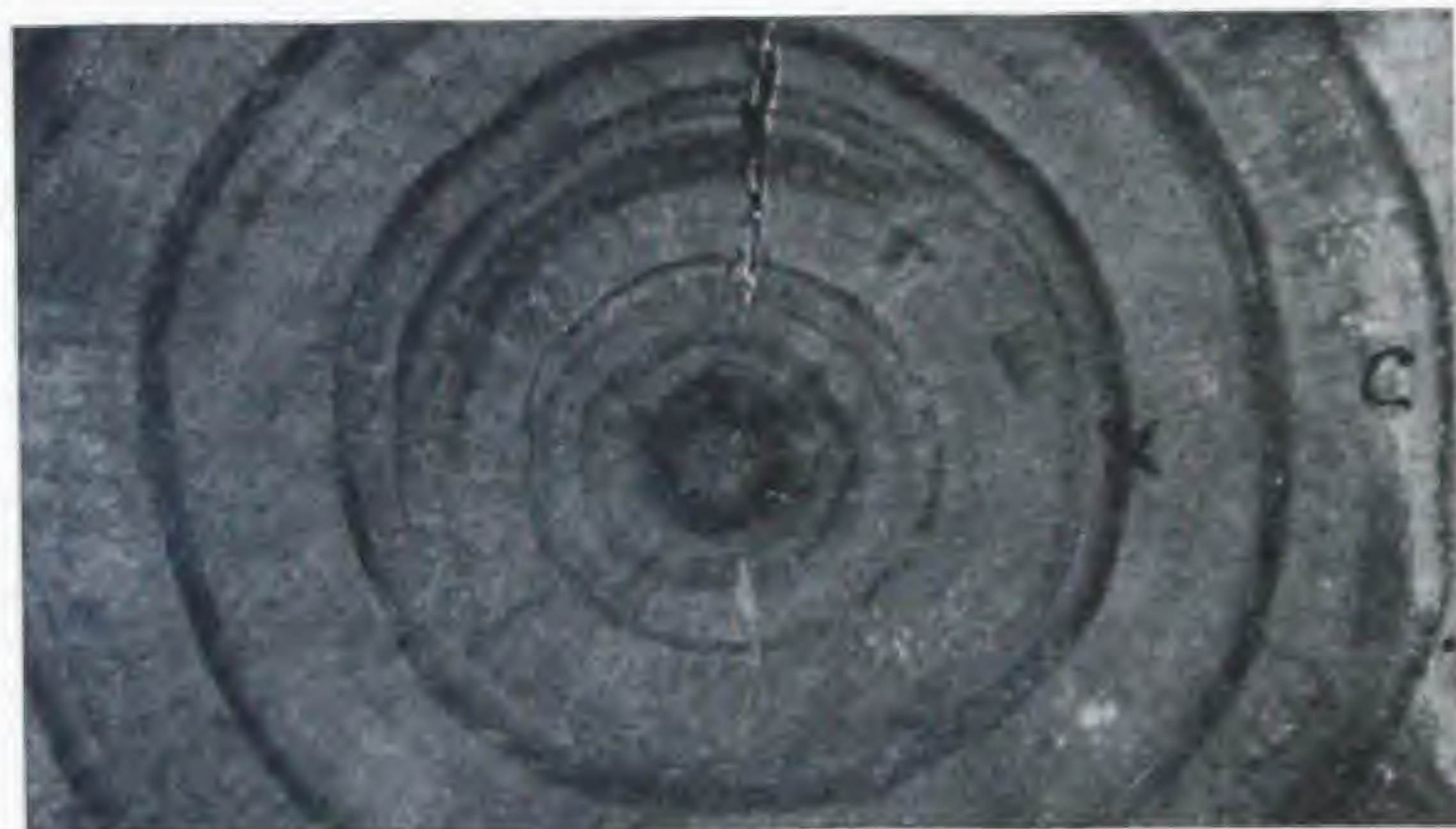
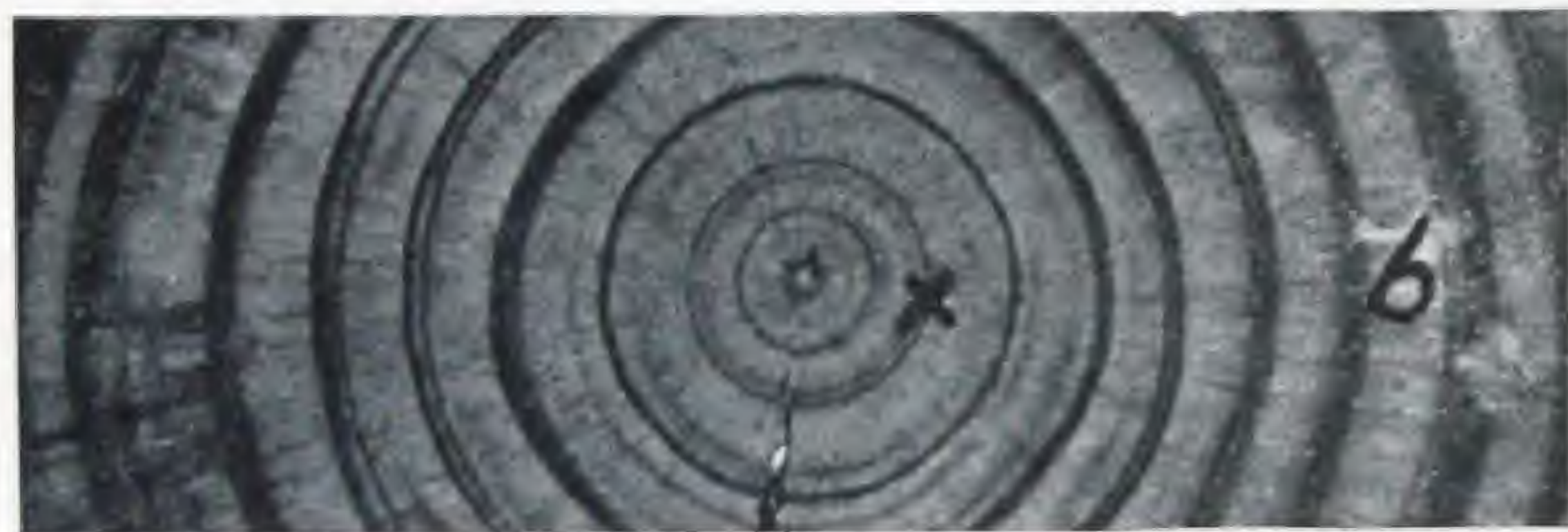


Fig. 4.—Loblolly pine—a, slow; b, medium; c, rapid growth near center; x, second annual ring. Actual size.

first necessary to cut with a sharp knife a smooth surface showing these structures. Moistening the wood often brings out the structural features more clearly. With a rule graduated in twenty-fifths or fiftieths of an inch, the average diameter of the pith not including small projections can be measured. A reading glass or low power hand lens is helpful but not essential in making this measurement.

If the intersection of the lines on the diagram representing the diameter of the pith and of the second annual ring of a specimen falls below the line (AB) it indicates that the specimen is not longleaf and may be either loblolly or shortleaf. Should the point of intersection fall close to the line (AB) a measurement on the other end of the specimen may result in more definite indications.

Obviously this method of identification can be used only on timbers, ties or other pieces containing the pith, but it is, as a rule, only regarding large pieces that the lumberman or contractor desires to know the exact species. Furthermore, this method does not exclude the minor southern pines, which, however, are comparatively rare in the lumber markets. Occasional pieces of Cuban pine might be classed as longleaf by this method.

MICROSCOPICAL DIFFERENCES

The more minute microscopical distinctions found for these three species can not be given in detail here but will be published in a technical journal. Briefly it may, however, be said that the leaf traces, vertical resin ducts, medullary rays, especially those containing resin ducts, and the ray tracheids afford helpful and dependable criteria for identification of the species.

THE LEAF TRACES

The leaf traces can be seen but not measured with the naked eye in the first and second annual rings where they appear as numerous miniature "knots" (Fig. 2). They are a continuation of the

woody part of the leaf clusters that clothe each year's new growth and persist for several years. The leaf traces like the leaf clusters are largest in longleaf and smallest in shortleaf. In loblolly they are intermediate and overlap the other two species in size.

OTHER CHARACTERS

The vertical resin ducts and the medullary rays containing the horizontal resin ducts also were found to average considerably larger in longleaf than in the other two species. The projections on the walls of the ray tracheids were found to be less reticulate in loblolly, as pointed out by Penhallow in North American Gymnosperms, but this feature was found to be influenced to some extent by the rate of growth.

SUMMARY FOR VISUAL METHOD

1—See if pith is present at ends of stick. (If pith is not present the specimen can not be identified without a microscope.)

2—With sharp knife smooth the pith and surrounding wood. If knots are present at that point try the other end.

3—If the pith is not clear try moistening the smoothed surface.

4—With finely graduated rule carefully measure the average diameter of the pith. Use a reading glass or low power hand lens if available.

5—If the pith is 0.10 inch or less in diameter the specimen is not longleaf.

6—If the pith is over 0.10 inch in diameter also measure the diameter of the second annual ring. Be careful not to mistake the first or third annual ring for the second.

7—On the chart find the point of intersection of the line representing the diameter of the pith with the line representing the diameter of the second annual ring.

8—If this point is below the line (AB) the specimen is not longleaf.

9—If this point is above the line (AB) the specimen is longleaf or, in rare instances, it may be Cuban pine.

10—If the point of intersection is close to the line (AB) make measurements on the other end of the specimen.

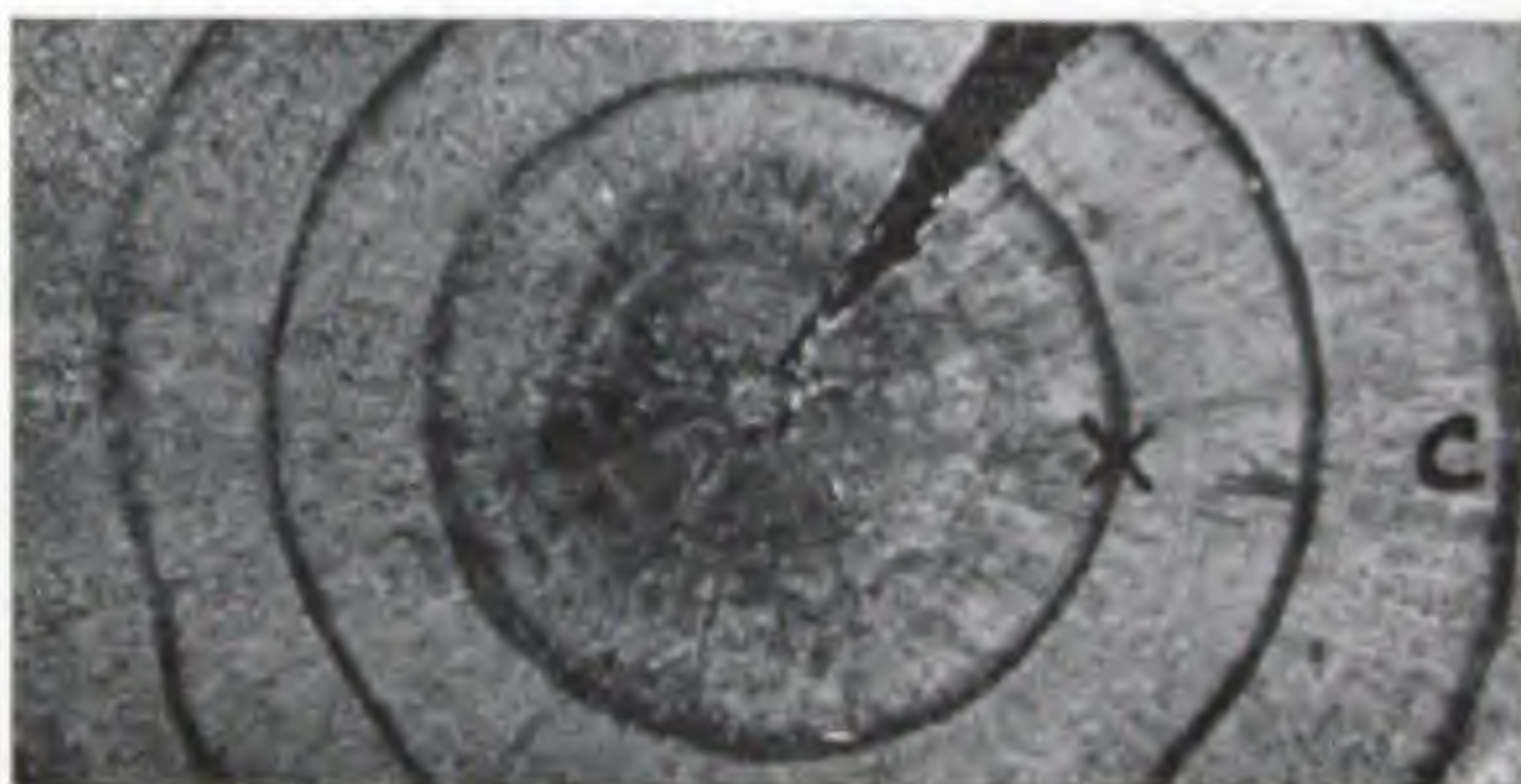


Fig. 5.—Shortleaf pine—*a*, slow; *b*, medium; *c*, rapid growth near center; *x*, second annual ring. Actual size.

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